Estimation of Primary Productivity and Seasonal Changes in Certain Tropical Reservoirs of Mahoba District, Uttar Pradesh, India

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***Abstract*- The present investigation was carried out during 2017-18 to 2018-19 to understand primary productivity status of four reservoirs, which are Chandrawal reservoir, Kabrai reservoir, Raipura reservoir and Salarpur reservoir based in Mahoba district, Uttar Pradesh, India. Whole experiment was done by using Light and Dark bottle method to estimate the Dissolved Oxygen (DO) quantity and to study the seasonal variations of Gross Primary Productivity, Net Primary Productivity and Community Respiration. During the study period it was noticed that the value of GPP, NPP and CR were increased in Pre-monsoon season but in winter it was lower than Pre-monsoon season but the fluctuation in all the reservoirs were negligible. The highest GPP was recorded in Raipura reservoir and it was 1.57mg.C/l/d and highest NPP was recorded 1.20mg.C/l/d. The maximum value of GPP and NPP respectively during pre-monsoon 0.89 and 0.53mg.C/l/d respectively due to penetration of more light into water body.**

***Index Terms*- Primary Productivity, GPP, NPP, CR, Reservoir.**

I. INTRODUCTION

Primary Productivity is basically a measure of the photosynthetic activity of the micro algae. Primary productivity helps in measuring the ability of an area to support a biological population and sustain a level of growth and respiration. The fixation of sunlight by plants and other autotrophic organisms initiates the flow of energy through an ecosystem. The rate at which this energy accumulates is called primary productivity, according to Odum and Barrett. The primary productivity of a water body is the manipulation of its biological production. It forms the basis of the ecosystem functioning (Odum, 1971).Primary production is influenced by biotic as well as abiotic factors. Enrichment of nutrient and dry matter in the reservoir affects diversity of plankton and physico-chemical characters of water. It plays an important role in energy and organic matters available to the entire biological community (Ahmed et al, 2005).In anticipation of the fisheries potential of the reservoirs, studies of reservoir characteristics that influence fish production, such as phytoplankton availability, distribution and production as well as bio-chemical parameters that could influence the phytoplankton were assessed at the formative years of the Reservoir. Uttar Pradesh, the Northern Province, is the most populous State of India, occupying 9% of the total geographical area of the country, sixty-six reservoirs with an area of 1,37,034 ha are distributed among 17 districts. Mahoba district based in southern part of UP, have some major reservoirs which are all used for irrigation as well as aquaculture purpose. In Mahoba district there are four major dams has been undertaken to assess the seasonal variations of primary productivity, namely Chandrawal Reservoir, Kabrai Reservoir, Raipura Reservoir and Salarpur Reservoir.

II. MATERIAL AND METHODS

For estimation of primary productivity, the water samples were collected from Site 1 and Site 2 of each reservoir. Site 1 considered as bank of the reservoir and Site 2 was middle portion of the reservoir. The sampling period was continued for three seasons' viz., Pre-monsoon, Post monsoon and Winter seasons for two years 2017-18 to 2018-19. The Pre-monsoon season was for the period of three months, April, May and June and Post monsoon season was for September and October month and November, December and January was considered as Winter season. The primary productivity was determined by standered "light and dark bottle" method followed by Gaarder and Gran (1927) and the quantity of dissolved oxygen was analyzed by initial bottle and light and dark bottle method of Winkler (Wetzel and Linkens 2000). After determination of all samples, we observed Gross Primary Productivity (GPP), Net Primary Productivity (NPP) and Community Respiration (CR) of all the four reservoirs.

III. RESULTS

In this present experiment we observed the primary productivity of Chandrawal reservoir, Kabrai reservoir,Raipura reservoir and Salarpur reservoir. Seasonal variability of Primary Productivity as GPP, NPP and CR of all the reservoirs is depicted from Table 1 to Table 8.

Average GPP maximum in year 2017-2018 of Chandrawal reservoir 1.18mgC/l/d& 1.15mgC/l/d in month of October & September and minimum was 0.48mgC/l/d in month of June in pre monsoon season. Average NPP was maximum 1.04mgC/l/d & 1.03mgC/l/d in the month of September &October in post monsoon season. Average CR was maximum in month of January 0.25mgC/l/d in winter season and minimum was 0.09mgC/l/d &0.1mgC/l/d in month of November & September in pre monsoon and post

monsoon season and winter season. In Kabrai reservoir according to the observation of year 2017-18 average GPP was maximum in winter season and post monsoon season was 1.25mgC/l/d in month of November& 1.23mgC/l/d in month of September and October whereas minimum GPP was in pre monsoon season in month of June. Average NPP was observed maximum in month of September 1.09mgC/l/d in post monsoon season and minimum was .032 in month of May in pre monsoon season. In year 2018-2019 average GPP was maximum in post monsoon season was 1.29mgC/l/d in month of September and October whereas minimum GPP was in pre monsoon season in month of June was 0.56mgC/l/d. Average NPP was observed maximum in month of September 1.09mgC/l/d in post monsoon season and minimum was 0.35 in month of April and June in pre monsoon season.

Table 1 Analysis of Primary Productivity of Chandrawal reservoir in the year 2017-2018.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean±SD	S-I	S-II	Mean±SD	S-I	S-II	Mean±SD
2017 - 2018	Pre-Monsoon	April	0.5	0.5625	0.53 ±0.04	0.34375	0.375	0.35 ±0.02	0.15625	0.1875	0.17±0.02
		May	0.4375	0.5625	0.5 ±0.08	0.21875	0.34375	0.28 ±0.08	0.21875	0.21875	0.21 ± 0
		June	0.5	0.46875	0.48 ±0.02	0.34375	0.28125	0.31 ±0.04	0.15625	0.1875	0.17±0.02
	Post-Monsoon	Sept	1.125	1.1875	1.15 ±0.04	1.03125	1.0625	1.04 ±0.02	0.09375	0.125	0.10±0.02
		Oct	1.15625	1.21875	1.18 ±0.04	1.03125	1.03125	1.03 ± 0	0.125	0.1875	0.15±0.04
	Winter	Nov	1.0625	1.125	1.09 ±0.04	1	1	1 ± 0	0.0625	0.125	0.09±0.04
		Dec	0.96875	0.875	0.92 ±0.06	0.84375	0.65625	0.75 ±0.13	0.125	0.21875	0.17±0.06
		Jan	0.9375	0.6875	0.81 ±0.17	0.65625	0.46875	0.56 ±0.13	0.28125	0.21875	0.25±0.04

Figure 1 Graphical analysis of Primary Productivity of Chandrawal reservoir in the year 2017-2018.

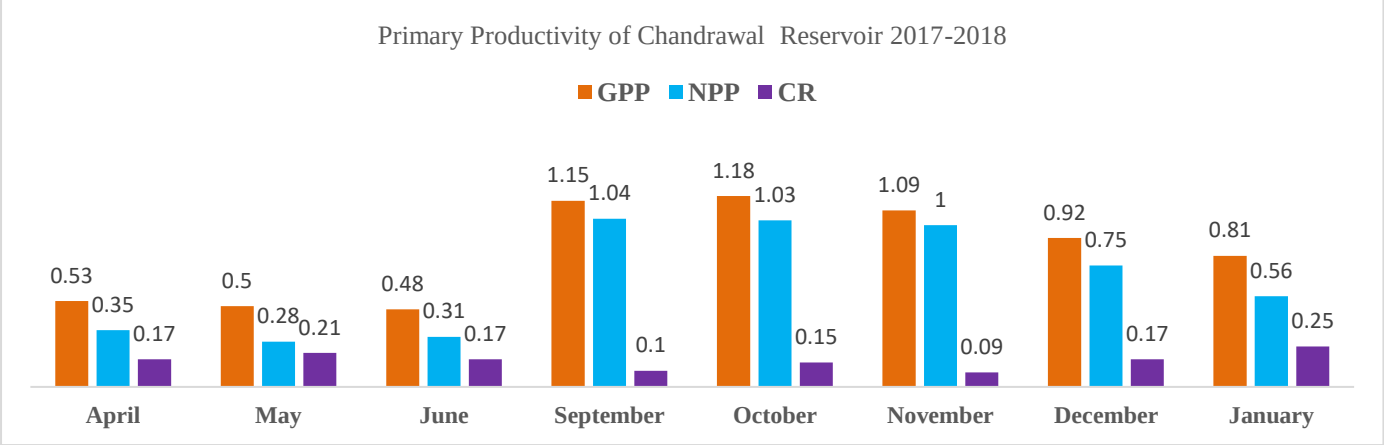


Table 2 Analysis of Primary Productivity of Chandrawal reservoir in the year 2018-2019.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean±SD	S-I	S-II	Mean±SD	S-I	S-II	Mean±SD
2018-2019	Pre-Monsoon	April	0.5625	0.46875	0.51 ±0.06	0.4375	0.3125	0.37 ±0.08	0.125	0.15625	0.14 ±0.02
		May	0.4375	0.53125	0.48 ±0.06	0.3125	0.25	0.28 ±0.04	0.125	0.21875	0.17 ±0.06
		June	0.5625	0.40625	0.48 ±0.11	0.34375	0.21875	0.28 ±0.08	0.21875	0.1875	0.20 ±0.02
	Post-Monsoon	Sept	1.25	1.1875	1.21 ±0.04	1.15625	1.03125	1.09 ±0.08	0.09375	0.15625	0.12 ±0.04
		Oct	1.21875	1.1875	1.20 ±0.02	1.0625	0.96875	1.01 ±0.06	0.15625	0.21875	0.18 ±0.04
		Nov	1.15625	1.03125	1.09 ±0.08	1	0.90625	0.95 ±0.06	0.15625	0.125	0.14 ±0.02
	Winter	Dec	0.9375	0.96875	0.95±0.02	0.84375	0.6875	0.76 ±0.11	0.09375	0.28125	0.18 ±0.13
		Jan	0.875	0.90625	0.89 ±0.02	0.53125	0.625	0.57 ±0.06	0.34375	0.28125	0.31 ±0.04

Figure 2 Graphical analysis of Primary Productivity of Chandrawal reservoir in the year 2018-2019

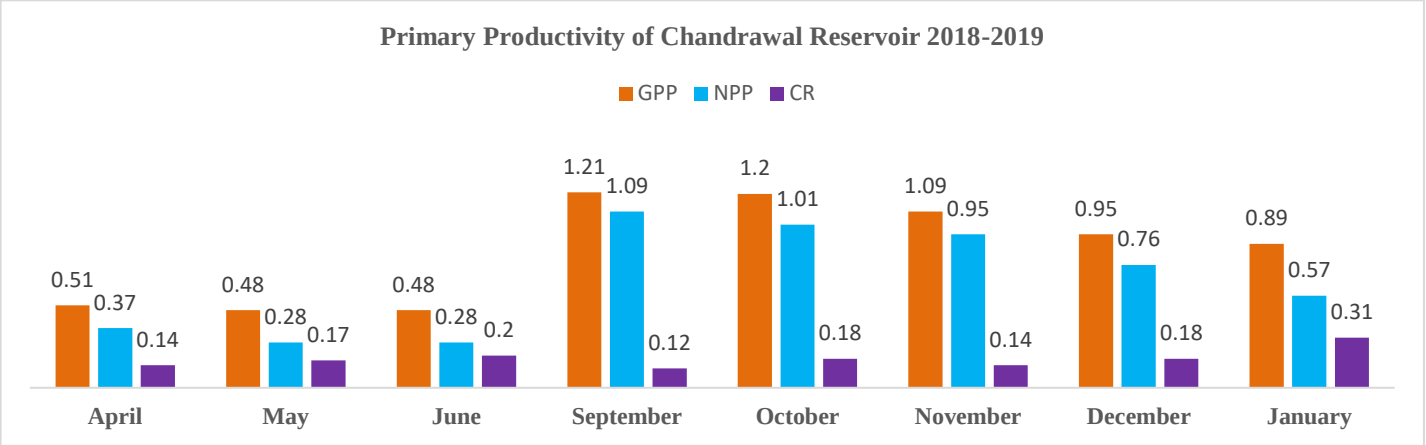


Table 3 Analysis of Primary Productivity of Kabrai reservoir in the year 2017-2018.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean±SD	S-I	S-II	Mean±SD	S-I	S-II	Mean±SD
2017-2018	Pre-Monsoon	April	0.53125	0.625	0.57 ± 0.04	0.3125	0.40625	0.35± 0.04	0.21875	0.21875	0.21±.0
		May	0.5	0.625	0.56± 0.06	0.25	0.40625	0.32± 0.07	0.25	0.21875	0.23±0.01
		June	0.5625	0.5	0.53± 0.03	0.40625	0.3125	0.35± 0.04	0.15625	0.1875	0.17±0.01
	Post-Monsoon	Sept	1.1875	1.28125	1.23± 0.04	1.09375	1.09375	1.09± 0	0.09375	0.1875	0.14±0.04
		Oct	1.25	1.21875	1.23± 0.01	1	1	1± 0	0.25	0.21875	0.23±0.01
	Winter	Nov	1.21875	1.28125	1.25± 0.03	0.875	1.03125	0.95± 0.07	0.34375	0.25	0.29±0.04
		Dec	1.09375	1.0625	1.07± 0.01	0.90625	0.65625	0.78± 0.12	0.1875	0.40625	0.29±0.10
		Jan	0.9375	1.03125	0.98± 0.04	0.5	0.90625	0.70± 0.20	0.4375	0.09375	0.26±0.17

Figure 3 Graphical analysis of Primary Productivity of Kabrai reservoir in the year 2017-2018.

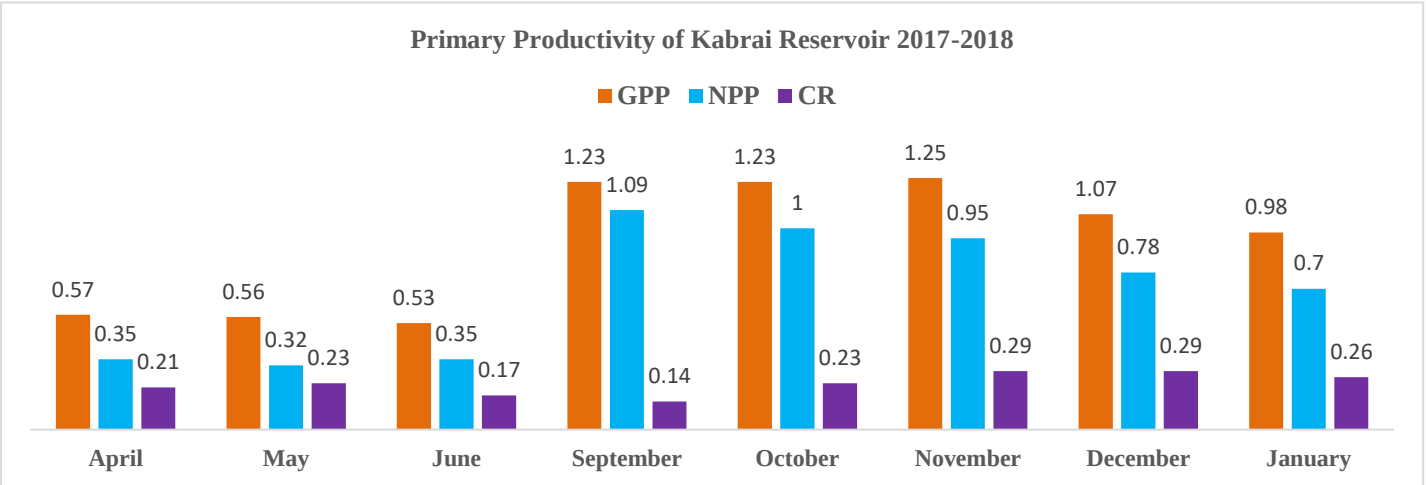
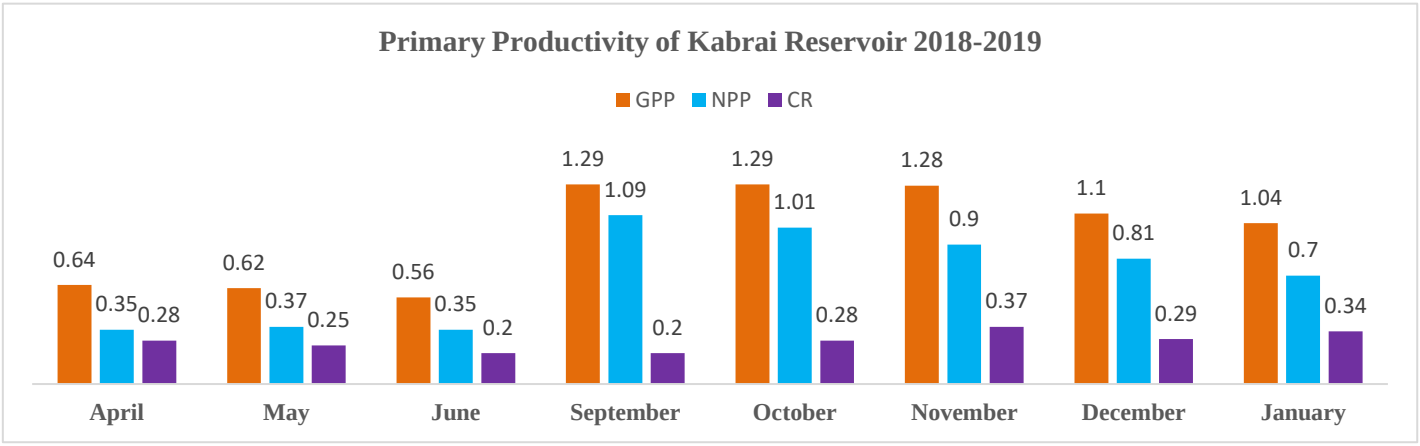


Table 4Analysis of Primary Productivity of Kabrai reservoir in the year 2018-2019.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean±SD	S-I	S-II	Mean±SD	S-I	S-II	Mean±SD
2018-2019	Pre-Monsoon	April	0.6875	0.59375	0.64 ± 0.04	0.375	0.34375	0.35 ± 0.01	0.3125	0.25	0.28 ± 0.03
		May	0.5625	0.6875	0.62 ± 0.06	0.28125	0.46875	0.37 ± 0.09	0.28125	0.21875	0.25 ± 0.03
		June	0.625	0.5	0.56 ± 0.06	0.375	0.34375	0.35 ± 0.01	0.25	0.15625	0.20 ± 0.04
	Post-Monsoon	Sept	1.25	1.34375	1.29± 0.04	1.125	1.0625	1.09 ± 0.03	0.125	0.28125	0.20 ± 0.07
		Oct	1.3125	1.28125	1.29 ± 0.01	0.96875	1.0625	1.01 ± 0.04	0.34375	0.21875	0.28 ± 0.06
	Winter	Nov	1.25	1.3125	1.28 ± 0.03	0.8125	1	0.90 ± 0.09	0.4375	0.3125	0.37 ± 0.06
		Dec	1.125	1.09375	1.10 ± 0.02	0.9375	0.6875	0.81 ± 0.12	0.1875	0.40625	0.29 ± 0.10
		Jan	1	1.09375	1.04 ± 0.04	0.5	0.9	0.7 ± 0.2	0.5	0.19375	0.34 ± 0.15

Figure 4 Graphical analysis of Primary Productivity of Kabrai reservoir in the year 2018-2019.



From the following observations of Raipura Reservoir in the year 2017-18, average GPP was maximum in post monsoon season was 1.54mgC/l/d in month of September whereas minimum GPP was 0.75mgC/l/d in pre monsoon season in month of June. In year 2018-2019 average GPP was maximum in post monsoon season was 1.57mgC/l/d in month of September whereas minimum GPP was in pre monsoon season in month of June was 0.78mgC/l/d. Average NPP was observed maximum in month of September 1.17mgC/l/d in post monsoon season and minimum was 0.5mgC/l/d in month of April & May in pre monsoon season. Average CR was observed maximum in month of December and January 0.45mgC/l/d in winter season and minimum was observed 0.26mgC/l/d in month of June in pre monsoon season. In case of Salarpur reservoir average GPP was recorded in post monsoon season 1.45mgC/l/d in month of September (2017-18) whereas minimum GPP was recorded 0.67mgC/l/d in month of June, in pre monsoon season (2017-18). Maximum average NPP was recorded in post monsoon season was 1.12mgC/l/d in month of September (2017-18) and minimum was recorded 0.43mgC/l/d in month of June & April in pre monsoon season (2017-18).

Table 5 Analysis of Primary Productivity of Raipura reservoir in the year 2017-2018.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean±SD	S-I	S-II	Mean±SD	S-I	S-II	Mean±SD
2017-2018	Pre Monsoon	April	0.9375	0.8125	0.87 ±0.06	0.5625	0.4375	0.5 ±0.06	0.375	0.375	0.37 ± 0
		May	0.84375	0.90625	0.87 ±0.03	0.5	0.5	0.5 ± 0	0.34375	0.40625	0.37 ±0.03
		June	0.84375	0.65625	0.75 ±0.09	0.5	0.46875	0.48 ±0.01	0.34375	0.1875	0.26±0.07
	Post Monsoon	Sept	1.53125	1.5625	1.54 ±0.01	1.21875	1.125	1.17 ±0.04	0.3125	0.4375	0.37 ±0.06
		Oct	1.53125	1.5	1.51 ±0.01	1.0625	1.09375	1.07 ±0.01	0.46875	0.40625	0.43 ±0.03
	Winter	Nov	1.4375	1.40625	1.42 ±0.01	0.9375	1.03125	0.98 ±0.04	0.5	0.375	0.43 ±0.06
		Dec	1.375	1.3125	1.34 ±0.03	1.03125	0.75	0.89 ±0.14	0.34375	0.5625	0.45 ±0.10
		Jan	1.25	1.21875	1.23 ±0.01	0.6875	0.88125	0.78 ±0.09	0.5625	0.3375	0.45 ±0.10

Figure 5 Graphical analysis of Primary Productivity of Raipura reservoir in the year 2017-2018.

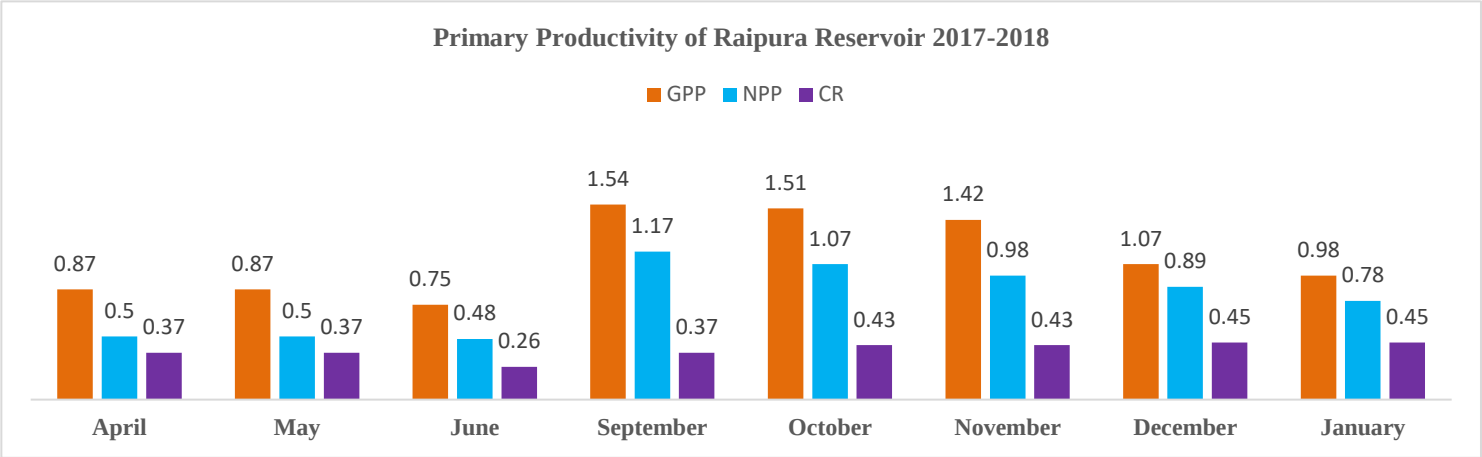


Table 6 Analysis of Primary Productivity of Raipura reservoir in the year 2018-2019.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean±SD	S-I	S-II	Mean±SD	S-I	S-II	Mean±SD
2018-2019	Pre-Monsoon	April	0.96875	0.8125	0.89 ±0.07	0.59375	0.4375	0.51 ±0.07	0.375	0.375	0.37 ±0
		May	0.875	0.8125	0.84 ±0.03	0.5625	0.4375	0.5 ±0.06	0.3125	0.375	0.34 ±0.03
		June	0.875	0.6875	0.78 ±0.09	0.53125	0.53125	0.53 ± 0	0.34375	0.15625	0.25 ±0.09
	Post-Monsoon	Sept	1.5625	1.5937	1.57 ±0.01	1.25	1.15625	1.20 ±0.04	0.3125	0.4375	0.37 ±0.06
		Oct	1.5625	1.5312	1.54 ±0.01	1.0625	1.125	1.09 ±0.03	0.5	0.40625	0.45 ±0.04
	Winter	Nov	1.4375	1.4687	1.45 ±0.01	0.9375	1.0625	1 ±0.06	0.5	0.40625	0.45 ±0.04
		Dec	1.40625	1.3125	1.35 ±0.04	1.09375	0.78125	0.93 ±0.15	0.3125	0.53125	0.42 ±0.10
		Jan	1.28125	1.21875	1.25 ±0.03	0.71875	0.8125	0.76 ±0.04	0.5625	0.40625	0.48 ±0.07

Figure 6 Graphical analysis of Primary Productivity of Raipura reservoir in the year 2018-2019.

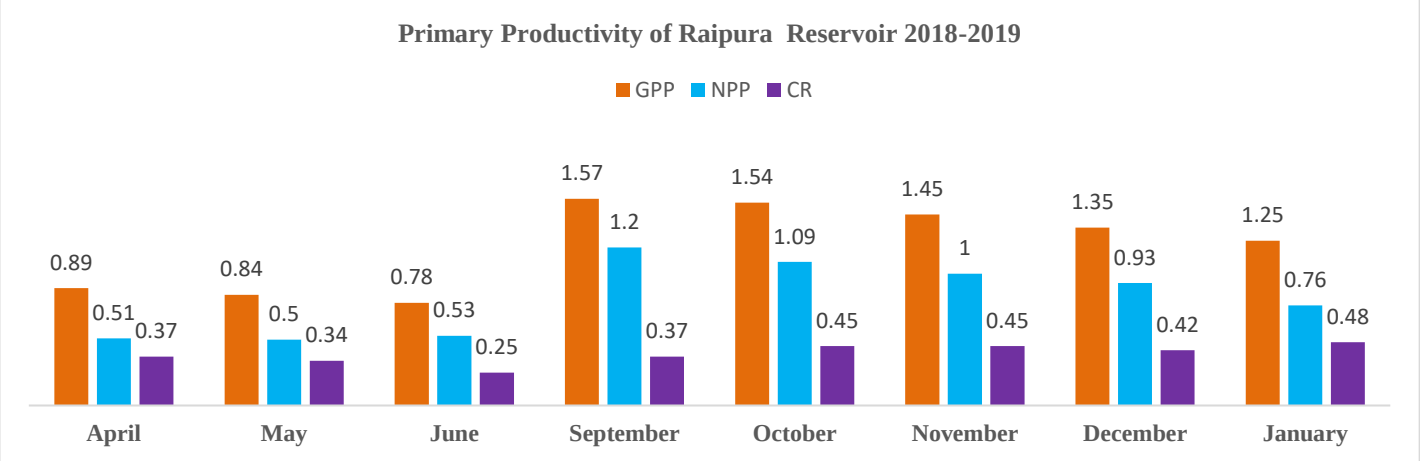


Table 7 Analysis of Primary Productivity of Salarpur reservoir in the year 2017-2018.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean±SD	S-I	S-II	Mean±SD	S-I	S-II	Mean±SD
2017-2018	Pre-Monsoon	April	0.84375	0.6875	0.76 ±0.11	0.53125	0.34375	0.43 ± 0.13	0.3125	0.34375	0.32 ± 0.02
		May	0.75	0.78125	0.76 ±0.02	0.4375	0.5	0.46 ± 0.04	0.3125	0.28125	0.29 ± 0.02
		June	0.78125	0.5625	0.67 ±0.15	0.5	0.375	0.43 ± 0.08	0.28125	0.1875	0.23 ± 0.06
	Post-Monsoon	Sept	1.40625	1.5	1.45 ±0.06	1.15625	1.09375	1.12 ± 0.04	0.25	0.40625	0.32 ± 0.11
		Oct	1.4375	1.40625	1.42 ±0.02	1	1.09375	1.04 ± 0.06	0.4375	0.3125	0.37 ± 0.08
	Winter	Nov	1.375	1.34375	1.35 ±0.02	0.875	1.03125	0.95 ± 0.11	0.5	0.3125	0.40 ± 0.13
		Dec	1.3125	1.21875	1.26 ±0.06	0.96875	0.6875	0.82 ± 0.19	0.34375	0.53125	0.43 ± 0.13
		Jan	1.15625	1.15625	1.15 ±0	0.65625	1.10625	0.88 ± 0.31	0.5	0.05	0.27 ± 0.31

Figure 7 Graphical Analysis of Primary Productivity of Salarpur reservoir in the year 2017-2018.

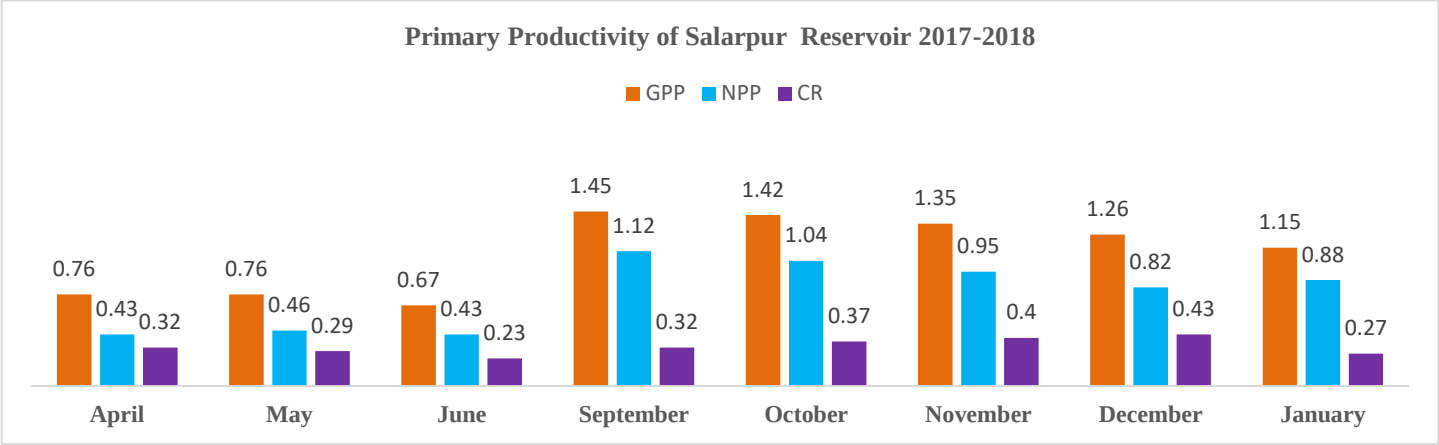
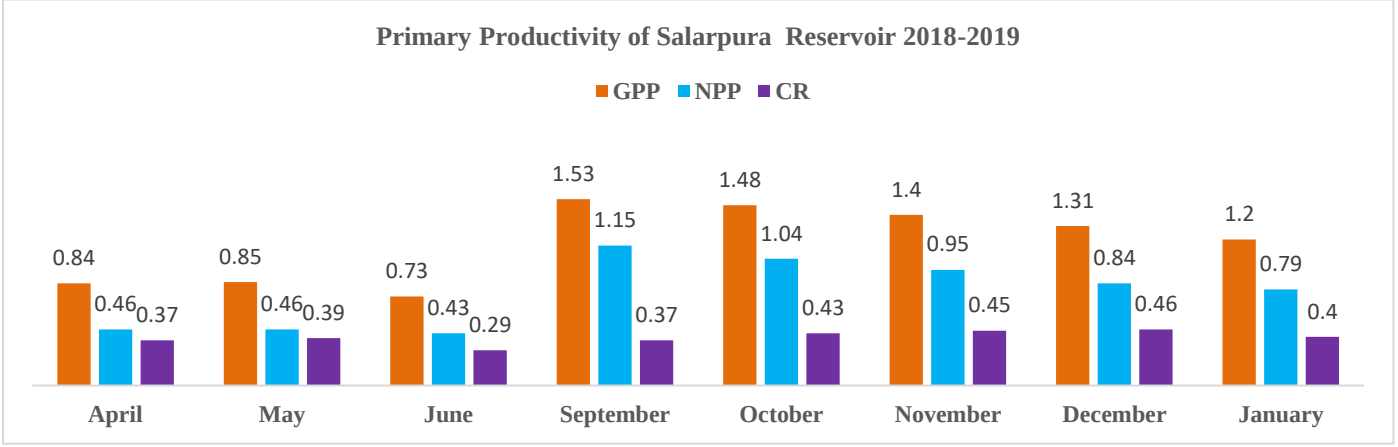


Table 8 Analysis of Primary Productivity of Salarpur reservoir in the year 2018-2019.

Year	Season	Month	GPP			NPP			CR		
			S-I	S-II	Mean ±SD	S-I	S-II	Mean ±SD	S-I	S-II	Mean± SD
2018-2019	Pre-Monsoon	Apr	0.90625	0.78125	0.84 ±0.08	0.53125	0.40625	0.46±0.08	0.375	0.375	0.37 ±0
		May	0.84375	0.875	0.85 ±0.02	0.46875	0.46875	0.46±0	0.375	0.40625	0.39±0.02
		June	0.84375	0.625	0.73 ±0.15	0.46875	0.40625	0.43 ±0.04	0.375	0.21875	0.29±0.11
	Post-Monsoon	Sept	1.5	1.5625	1.53 ±0.04	1.1875	1.125	1.15±0.04	0.3125	0.4375	0.37 ±0.08
		Oct	1.5	1.46875	1.48 ±0.02	1.03125	1.0625	1.04±0.02	0.46875	0.40625	0.43±0.04
	Winter	Nov	1.4375	1.375	1.40 ±0.04	0.90625	1	0.95±0.06	0.53125	0.375	0.45±0.11
		Dec	1.34375	1.28125	1.31 ±0.04	0.96875	0.71875	0.84±0.17	0.375	0.5625	0.46±0.13
		Jan	1.21875	1.187	1.20 ±0.02	0.6875	0.90625	0.79±0.15	0.53125	0.28125	0.40±0.17

Figure 8 Graphical analysis of Primary Productivity of Salarpur reservoir in the year 2018-2019.



IV. CONCLUSION

The above observations revealed that, the entire 4 reservoirs are productive in nature. The peak of productivity was observed during pre-monsoon season and the secondary peak was noticed during post-monsoon season in case of every reservoir. The primary production might have been influence by nutrient availability during pre-monsoon due to evaporation of water and bright sunlight, while the organic runoff from agriculture and nutrient coming along with the rainfall during monsoon played the major role in the development of primary productivity latter during the post-monsoon season. From the above result it can be concluded that, indicates higher productivity nature of the ecosystem and therefore is likely to be a potential source of fish production for commercial purpose and also suitable for culture-based capture fishery.

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